SAMSUNG ELECTRONICS

Approval

To : Customer

Date : 2005-01-31

SAMSUNG TFT-LCD

MODEL NO. : LTM170EX-L21

Approved by :

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Any Modification of Spec is not allowed without SEC's permission.

Senior Manager : *Y.D. Jo*

PREPARED BY : LCD Business Technical Customer Service Team

Samsung Electronics Co . , LTD.

wise view SAMSUNG TFT-LCD

Contents

* Revision History

Approval

Date	Rev. No	Page	Summary
Jan. 31, 2005	000		Approval specification of LTM170EX-L21 model was issued first.

* Description

LTM170EX-L21 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a back-light system. The resolution of a 17.0" contains 1280 x 1024 pixels and can display up to 16.2 million colors.

* Features

- High contrast ratio, high aperture structure
- TN (Twisted Nematic) mode
- Wide viewing angle
- High speed response
- SXGA (1280 x 1024 pixels) resolution
- Low power consumption
- 2 dual CCFTs (Cold Cathode Fluorescent Tube)
- DE (Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface (2pixel/clock)
- Compact Size Design
- Pb-free configuration

* Applications

Workstation & desktop monitors
Display terminals for AV application products
Monitors for industrial machine
* If the module is used to other applications besides the above, please contact SEC in advance.

* General information

Items	Specification	Unit	Note
Display area	337.92(H) x 270.336(V)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16.2M	colors	
Number of pixels	1280 x 1024	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.264(H) x 0.264(W)	mm	
Display mode	Normally White		
Surface treatment	Haze 25% , Hard-coating (3H)		

*** Mechanical information**

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	354.4	354.9	355.4	mm
	Vertical(V)	289.8	290.3	290.8	mm
	Depth(D)	-	-	13.3	mm
Weight		-	-	1,700	g

1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

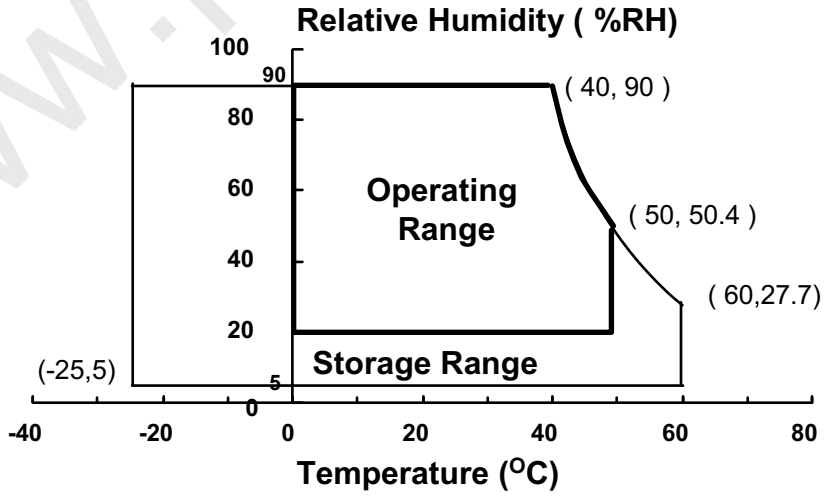
Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-25	60	℃	(1)
Operating temperature (Glass surface temperature)	T_{OPR}	0	50	℃	(1)
Shock (non - operating)	Snop	-	50	G	(2),(4)
Vibration (non - operating)	Vnop	-	1.5	G	(3),(4)

Note (1) Temperature and relative humidity range are shown in the figure below.
90 % RH Max. (40 °C ≥ Ta)
Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

(2) 11ms, sine wave, one time for ±X, ±Y, ±Z axis

(3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

(4) At vibration and shock test, the fixture which holds the module to be tested has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD Module (Vss = GND = 0 V)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	Vss-0.5	6.5	V	(1)

Note (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT (Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Lamp Current	I_L	3.0	8.0	mArms	(1),(2)
Lamp Frequency	f_L	40	80	kHz	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under Normal Operating Conditions.

(2) Specified values are for a single lamp.
(Refer to the Note (1) in the page 13 for further information.)

2. Optical Characteristics

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The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).

Measuring equipment : TOPCON BM-5A, BM-7, PHOTO RESEARCH PR650
Eldim EZ-Contrast

(Inverter Freq. : 50kHz) * Ta = 25 ± 2°C, V_{DD}=5V, fv= 60Hz, f_{DCLK}=54MHz, I_L = 7.5mA_{rms}

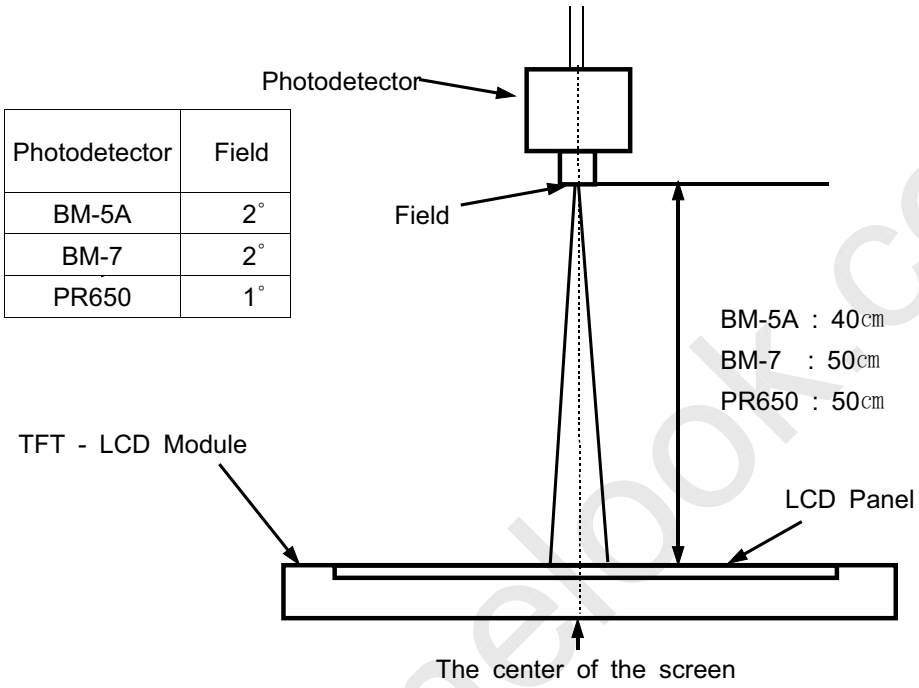
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$ Viewing Angle	500	700	-		(3) BM-5A
Response Time	Rising	T_R		-	2	4	msec	(5) BM-7
	Falling	T_F		-	6	10		
Luminance of White (Center of screen)		Y_L		250	300	-	cd/m2	(6) BM-5A
Color Chromaticity (CIE 1931)	Red	Rx		0.620	0.650	0.680		(7) PR650
		Ry		0.300	0.330	0.360		
	Green	Gx		0.270	0.300	0.330		
		Gy		0.570	0.600	0.630		
	Blue	Bx		0.120	0.150	0.180		
		By		0.050	0.080	0.110		
	White	Wx		0.283	0.313	0.343		
		Wy		0.299	0.329	0.359		
Color Chromaticity (CIE 1976)	Red	Ru'		-	0.459	-		
		Rv'		-	0.525	-		
	Green	Gu'		-	0.125	-		
		Gv'		-	0.563	-		
	Blue	Bu'		-	0.152	-		
		Bv'		-	0.196	-		
	White	Wu'		-	0.198	-		
		Wv'		-	0.468	-		
Viewing Angle	Hor.	θ L	CR≥10	65	75	-	Degrees	(8) BM-5A
		θ R		65	75	-		
	Ver.	ϕ H		65	75	-		
		ϕ L		50	60	-		
Brightness Uniformity (9 Points)		Buni		-	-	25	%	(4) BM-5A

Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min and 40min after lighting the back-light at the given temperature for stabilization of the back-light. This should be measured in the center of screen.

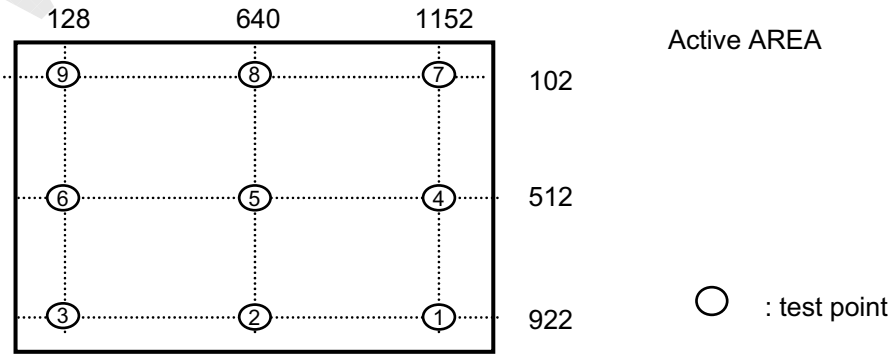
Single lamp current : 7.5mA (Refer to the note(1) in the page 13 for more information.)
Environment condition : Ta = 25 ± 2 °C

Photodetector	Field
BM-5A	2°
BM-7	2°
PR650	1°



Optical Measuring Equipment Setup

Note (2) Definition of test point



Note (3) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point⑤ of the panel

$$CR = \frac{G\max}{G\min}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

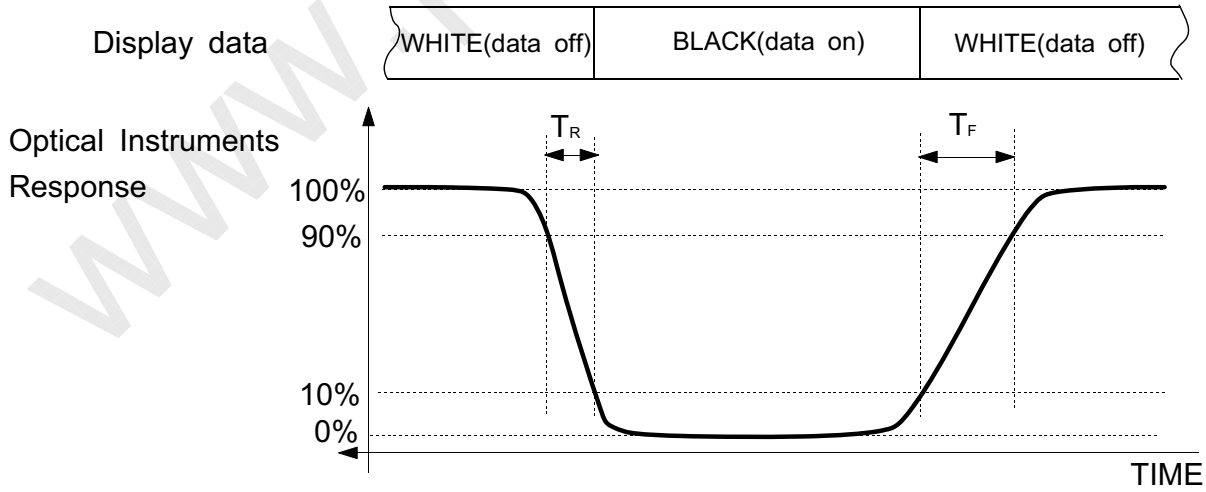
Note (4) Definition of 9 points brightness uniformity

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

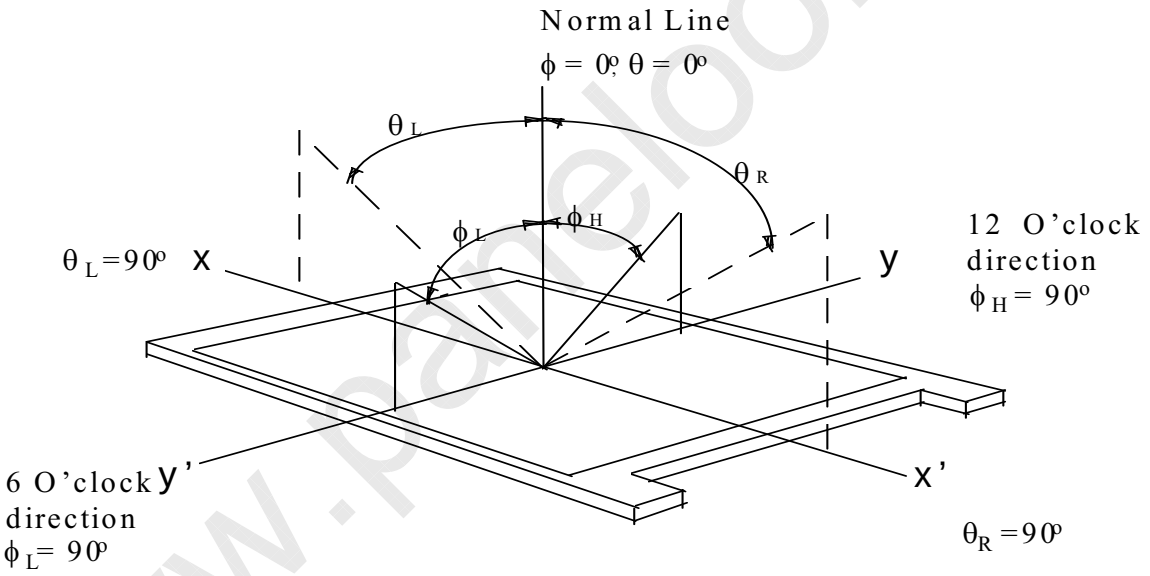
Note (5) Definition of Response time : Sum of Tr, Tf



Note (6) Definition of Luminance of White : Luminance of white at center point⑤

Note (7) Definition of Color Chromaticity (CIE 1931, CIE1976)
Color coordinate of Red, Green, Blue & White at center point⑤

Note (8) Definition of Viewing Angle : Viewing angle range (CR ≥10)



3. Electrical Characteristics

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3.1 TFT LCD MODULE

Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	4.5	5.0	5.5	V	(1)
Interface type		LVDS	DS90C383/385 DS90C386 Pair				
Current of Power Supply	(a) Black	I_{DD}	-	600	-	mA	(2),(3)
	(b) White		-	500	-	mA	
	(c) Dot		-	700	850	mA	
Vsync Frequency		f_V	55	60	77	Hz	(4)
Hsync Frequency		f_H	56.7	64	82.082	kHz	
Main Frequency		f_{DCLK}	40.0	54	69.28	MHz	
Rush Current		I_{RUSH}	-	-	3.0	A	(5)

Note (1) The connector for display data & timing signal should be connected.(Vss=0V)

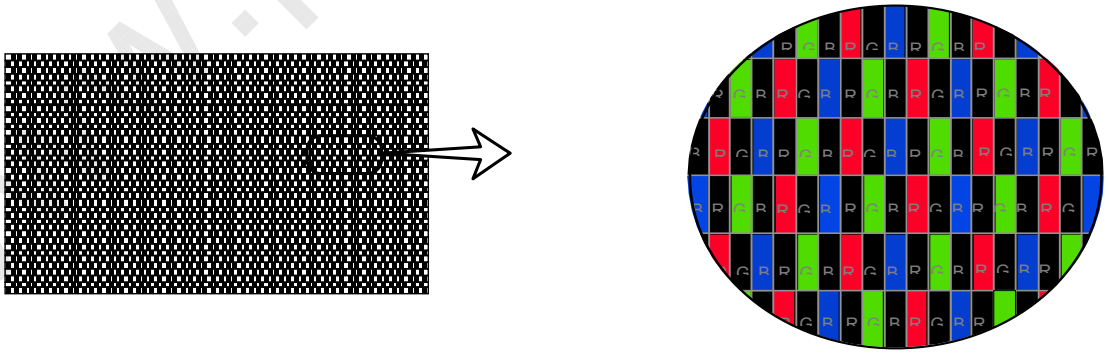
(2) f_V=60Hz, f_{DCLK} = 54MHz, V_{DD} = 5.0V, DC Current.

(3) Power dissipation check pattern(LCD Module only)

a) Black Pattern

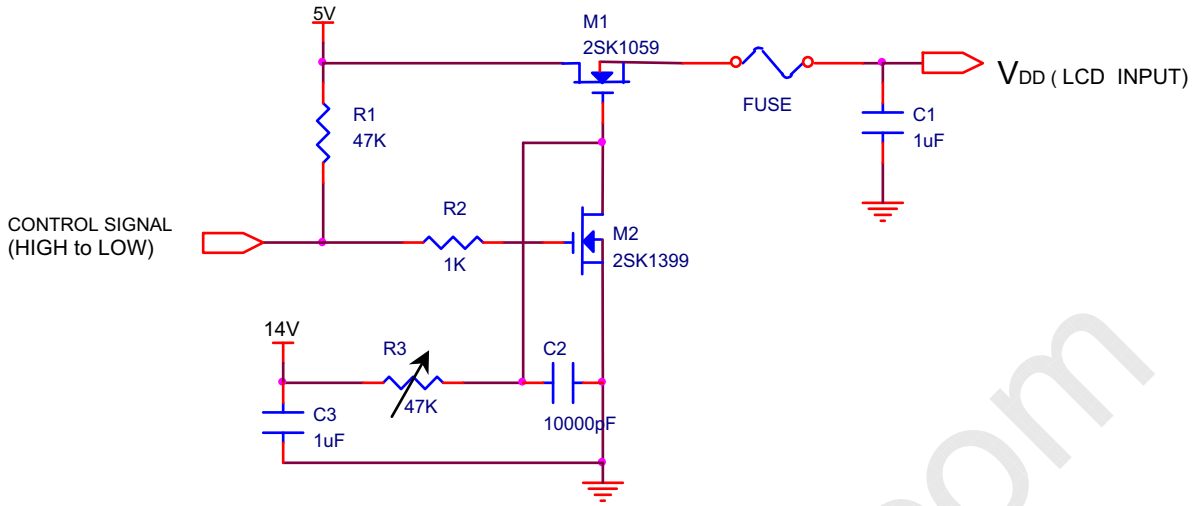
b) White Pattern

c) Dot Pattern



(4) At low Vsync frequency, under 60Hz, flicker level can increase at specific pattern.

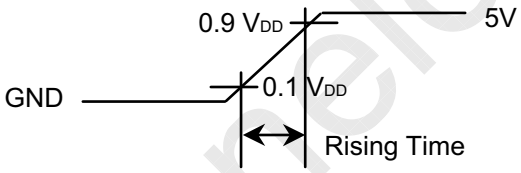
(5) Measurement Conditions



Control Signal : High(+5V) → Low(Ground)

All Signal lines to panel, except for power 5V : Ground

The rising time of supplied voltage is controlled to 470us by R3 and C2 value.



3.2 BACK-LIGHT UNIT

The back-light system is an edge - lighting type with 2 dual CCFTs (Cold Cathode Fluorescent Tube) The characteristics of two dual lamps are shown in the following tables.

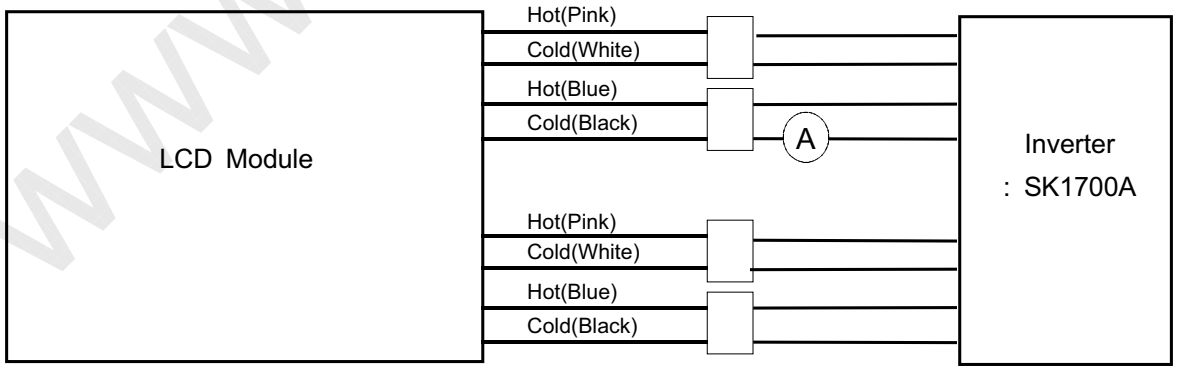
Ta=25 ± 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current		I_L	3.0	7.5	8.0	mArms	(1)
Lamp Voltage		V_L	-	565	-	Vrms	
Lamp Frequency		f_L	40	-	60	kHz	(2)
Operating Life Time		Hr	50,000	-	-	Hour	(3)
inverter waveform	asymmetry rate	W_{asy}	-	-	10	%	(6)
	distortion rate	W_{dis}	-	-	$\sqrt{2}$ ±10	%	
Startup Voltage		Vs	-	-	0℃ : 1,800 25℃: 1,580	Vrms	(4)

Note) The wave form of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(poor lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with current meter for high frequency as shown below.
Refer to the block diagram of the back-light unit in the next page for more information.
Specified values are for a single lamp.



(2) Lamp frequency which may produce interference with horizontal synchronous frequency may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Life time (Hr) of a lamp is defined as the time in which it continues to operate under the condition of Ta = 25±2°C and I_L = 7.5mArms for a lamp until the brightness becomes 50% or lower than its original value. Operating condition is lamp unit itself, not module assembly at operating current 7.5mA.

(4) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.

(5) Because the inverter uses high voltage, please disconnect it from the power before assembling or disassembling.

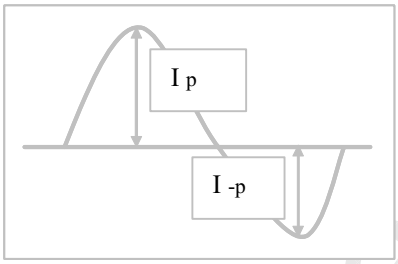
(6) The output of the inverter must have symmetrical(negative and positive) voltage waveform and current waveform.

Please do not use the inverter which has unsymmetrical voltage and current and spike wave. Designing a system inverter intended to have better display performance, power efficiency and lamp reliability, please follow the requirements the below. They would help increase the lamp lifetime and reduce leakage current.

a. The asymmetry rate of the inverter waveform should be less than 10%.

b. The distortion rate of the waveform should be within $\sqrt{2}$ ±10%.

* Inverter output waveform had better be more similar to ideal sine wave.



* Asymmetry rate:
$| I_p - I_{-p} | / I_{rms} \times 100\%$

* Distortion rate
I_p (or I_{-p}) / I_{rms}

4. Block Diagram

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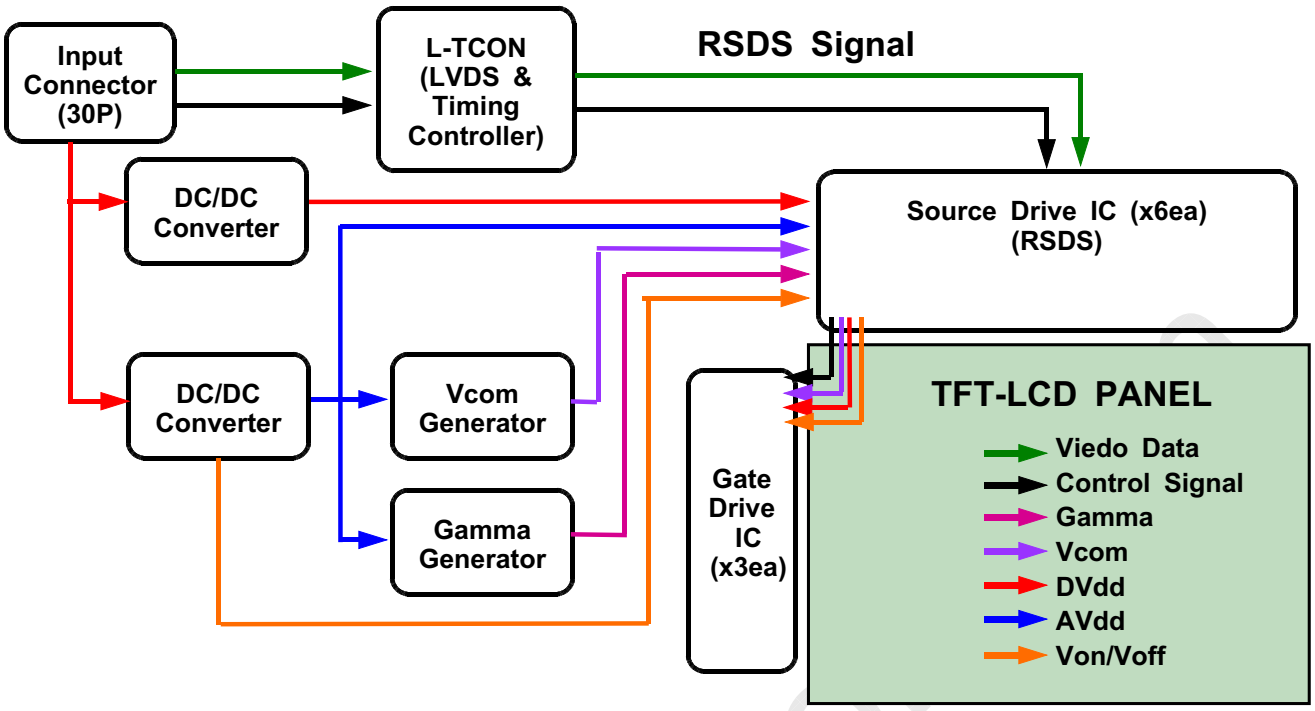
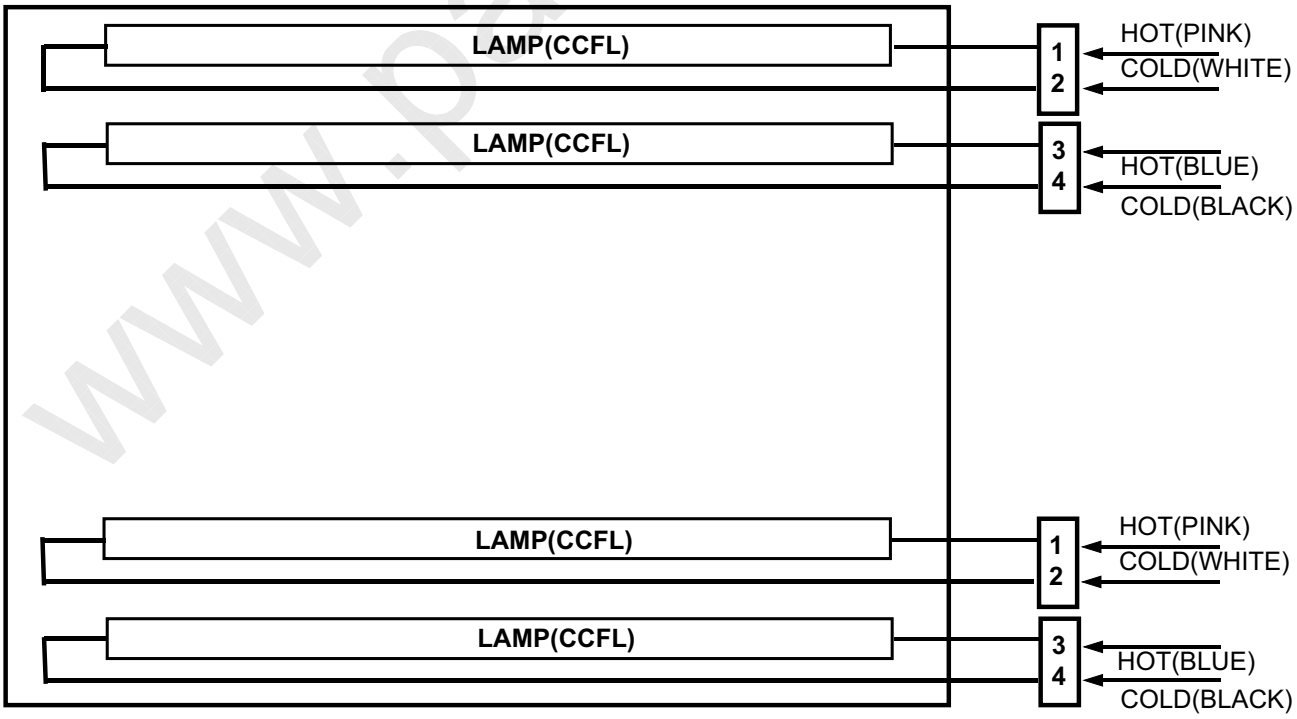
4.1 TFT LCD MODULE



4.2 BACK-LIGHT UNIT

Connector : Yeonho 35001HS-02L or equivalent



5. Input Terminal Pin Assignment

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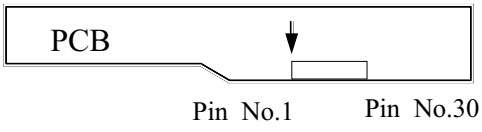
5.1. Input Signal & Power (Connector : UJU IN-30-OB 100 or equivalent)

PIN NO	SYMBOL	FUNCTION
1	RXO0-	Negative Transmission Data of Pixel 0 (ODD data)
2	RXO0+	Positive Transmission Data of Pixel 0 (ODD data)
3	RXO1-	Negative Transmission Data of Pixel 1 (ODD data)
4	RXO1+	Positive Transmission Data of Pixel 1 (ODD data)
5	RXO2-	Negative Transmission Data of Pixel 2 (ODD data)
6	RXO2+	Positive Transmission Data of Pixel 2 (ODD data)
7	GND	Power Ground
8	RXOC-	Negative Sampling Clock (ODD data)
9	RXOC+	Positive Sampling Clock (ODD data)
10	RXO3-	Negative Transmission Data of Pixel 3 (ODD data)
11	RXO3+	Positive Transmission Data of Pixel 3 (ODD data)
12	RXE0-	Negative Transmission Data of Pixel 0 (EVEN data)
13	RXE0+	Positive Transmission Data of Pixel 0 (EVEN data)
14	GND	Power Ground
15	RXE1-	Negative Transmission Data of Pixel 1 (EVEN data)
16	RXE1+	Positive Transmission Data of Pixel 1 (EVEN data)
17	GND	Power Ground
18	RXE2-	Negative Transmission Data of Pixel 2 (EVEN data)
19	RXE2+	Positive Transmission Data of Pixel 2 (EVEN data)
20	RXEC-	Negative Sampling Clock (EVEN data)
21	RXEC+	Positive Sampling Clock (EVEN data)
22	RXE3-	Negative Transmission Data of Pixel 3 (EVEN data)
23	RXE3+	Positive Transmission Data of Pixel 3 (EVEN data)
24	GND	Power Ground
25	NC	No Connection
26	NC	No Connection
27	NC	No Connection
28	V_{DD}	Power Supply : +5V
29		
30		

Note) Start from left side



5.2 LVDS Interface

5.2.1 Odd pixel data (1st pixel data)

1st LVDS Transmitter (***DS90C383, DS90C385***) Signal Interface						
Device Input Pin		Device Input Signal		Output Signal	To LTM170EX Interface (CN101)	
No	Symbol	Symbol	Function		Terminal	Symbol
51	TXIN0	RO0	Red Odd Pixel Data (LSB)	TXOUT0- TXOUT0+	No. 1 No. 2	RXO0- RXO0+
52	TXIN1	RO1	Red Odd Pixel Data			
54	TXIN2	RO2	Red Odd Pixel Data			
55	TXIN3	RO3	Red Odd Pixel Data			
56	TXIN4	RO4	Red Odd Pixel Data			
2	TXIN5	RO7	Red Odd Pixel Data (MSB)	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
3	TXIN6	RO5	Red Odd Pixel Data	TXOUT0- TXOUT0+	No. 1 No. 2	RXO0- RXO0+
4	TXIN7	GO0	Green Odd Pixel Data (LSB)			
6	TXIN8	GO1	Green Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
7	TXIN9	GO2	Green Odd Pixel Data			
8	TXIN10	GO6	Green Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
10	TXIN11	GO7	Green Odd Pixel Data (MSB)			
11	TXIN12	GO3	Green Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
12	TXIN13	GO4	Green Odd Pixel Data			
14	TXIN14	GO5	Green Odd Pixel Data			
15	TXIN15	BO0	Blue Odd Pixel Data (LSB)			
16	TXIN16	BO6	Blue Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+
18	TXIN17	BO7	Blue Odd Pixel Data (MSB)			
19	TXIN18	BO1	Blue Odd Pixel Data	TXOUT1- TXOUT1+	No. 3 No. 4	RXO1- RXO1+
20	TXIN19	BO2	Blue Odd Pixel Data	TXOUT2- TXOUT2+	No. 5 No. 6	RXO2- RXO2+
22	TXIN20	BO3	Blue Odd Pixel Data			
23	TXIN21	BO4	Blue Odd Pixel Data			
24	TXIN22	BO5	Blue Odd Pixel Data			
50	TXIN27	RO6	Red Odd Pixel Data	TXOUT3- TXOUT3+	No. 10 No. 11	RXO3- RXO3+

5.2.2 Even pixel data (2nd pixel data)

2nd LVDS Transmitter (***DS90C383, DS90C385***) Signal Interface						
Device Input Pin		Device Input Signal		Output Signal	To LTM170EX Interface (CN101)	
No	Symbol	Symbol	Function		Terminal	Symbol
51	TXIN0	RE0	Red Even Pixel Data (LSB)	TXOUT0- TXOUT0+	No. 12 No. 13	RXE0- RXE0+
52	TXIN1	RE1	Red Even Pixel Data			
54	TXIN2	RE2	Red Even Pixel Data			
55	TXIN3	RE3	Red Even Pixel Data			
56	TXIN4	RE4	Red Even Pixel Data			
2	TXIN5	RE7	Red Even Pixel Data (MSB)	TXOUT3- TXOUT3+	No. 22 No. 23	RXE3- RXE3+
3	TXIN6	RE5	Red Even Pixel Data	TXOUT0- TXOUT0+	No. 12 No. 13	RXE0- RXE0+
4	TXIN7	GE0	Green Even Pixel Data (LSB)			
6	TXIN8	GE1	Green Even Pixel Data	TXOUT1- TXOUT1+	No. 15 No. 16	RXE1- RXE1+
7	TXIN9	GE2	Green Even Pixel Data			
8	TXIN10	GE6	Green Even Pixel Data	TXOUT3- TXOUT3+	No. 22 No. 23	RXE3- RXE3+
10	TXIN11	GE7	Green Even Pixel Data (MSB)			
11	TXIN12	GE3	Green Even Pixel Data	TXOUT1- TXOUT1+	No. 15 No. 16	RXE1- RXE1+
12	TXIN13	GE4	Green Even Pixel Data			
14	TXIN14	GE5	Green Even Pixel Data			
15	TXIN15	BE0	Blue Even Pixel Data (LSB)			
16	TXIN16	BE6	Blue Even Pixel Data	TXOUT3- TXOUT3+	No. 22 No. 23	RXE3- RXE3+
18	TXIN17	BE7	Blue Even Pixel Data (MSB)			
19	TXIN18	BE1	Blue Even Pixel Data	TXOUT1- TXOUT1+	No. 15 No. 16	RXE1- RXE1+
20	TXIN19	BE2	Blue Even Pixel Data	TXOUT2- TXOUT2+	No. 18 No. 19	RXE2- RXE2+
22	TXIN20	BE3	Blue Even Pixel Data			
23	TXIN21	BE4	Blue Even Pixel Data			
24	TXIN22	BE5	Blue Even Pixel Data			
50	TXIN27	RE6	Red Even Pixel Data	TXOUT3- TXOUT3+	No. 22 No. 23	RXE3- RXE3+

5.3 BACK-LIGHT UNIT

	Pin No.	Input	Color	Function
Upper	1	Hot1	Pink	High Voltage
	2	Cold1	White	Ground
	3	Hot2	Blue	High Voltage
	4	Cold2	Black	Ground
Lower	1	Hot1	Pink	High Voltage
	2	Cold1	White	Ground
	3	Hot2	Blue	High Voltage
	4	Cold2	Black	Ground
	Connector Part No.	Yeonho 35001HS-02L or equivalent		

5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
	↑	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			R3~
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			R252
	↓	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252
	LIGHT	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R252
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
	↑	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			G3~
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			G252
	↓	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252
	LIGHT	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G252
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1
	↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			B3~
		:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			B252
	↓	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B252
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B252
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B252

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Interface Timing

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6.1 Timing Parameters (DE only mode)

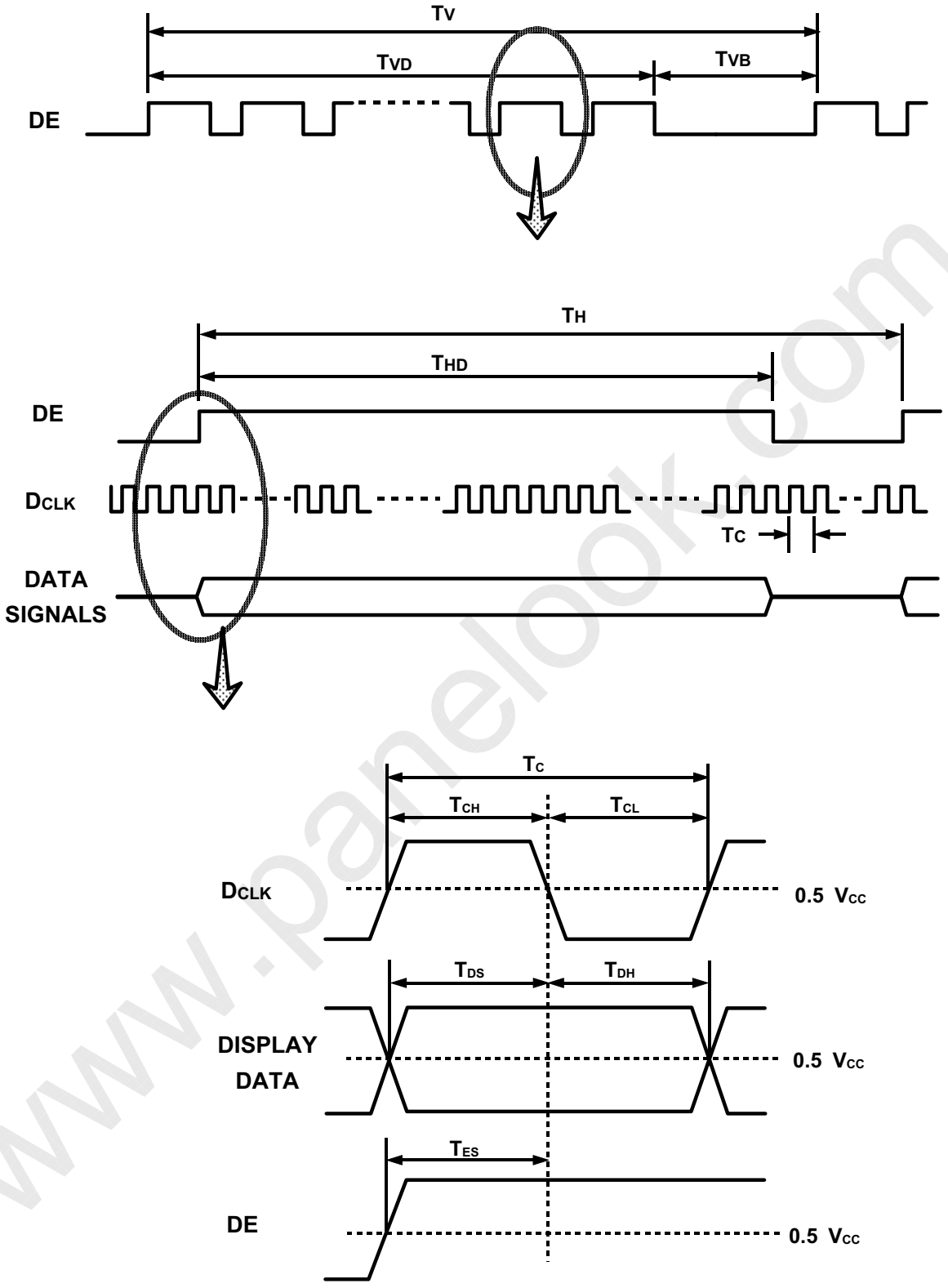
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/Tc	40	54	69.28	MHz	(1), (2)
	High Time	Tch	4	-	-	nsec	
	Low Time	Tcl	4	-	-	nsec	
Data	Setup Time	Tds	4	-	-	nsec	
	Hold Time	Tdh	4	-	-	nsec	
Data Enable	Setup Time	Tes	4	-	-	nsec	
Frame Frequency	Cycle	Tv	18.18	16.7	12.99	msec	
			1031	1066	-	lines	
	Frequency	Tvd	55	60	77	Hz	(3)
Vertical Active Display Term	Display Period	Tvb	1024	1024	1024	lines	
	Vertical Blank Period	Th	8	-	-	lines	
One Line Scanning Time	Cycle	Thd	752	844	1130	clocks	
Horizontal Active Display Term	Display Period		640	640	640	clocks	

Note (1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal Vcc = 3.3V

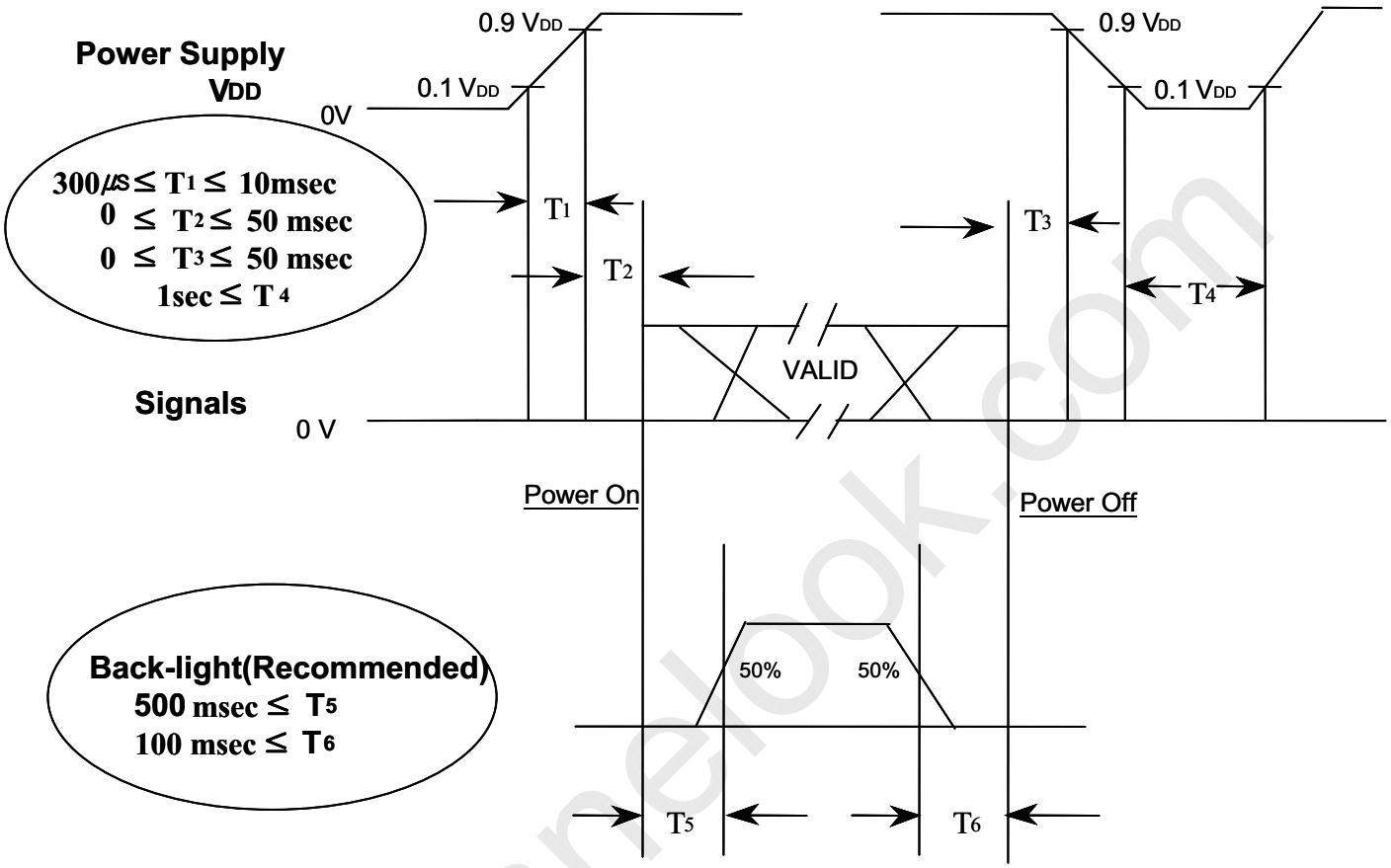
(3) At low Vsync frequency, Under 60Hz, flicker level can increase at specific pattern.

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



Power ON/OFF Sequence

Note. (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.

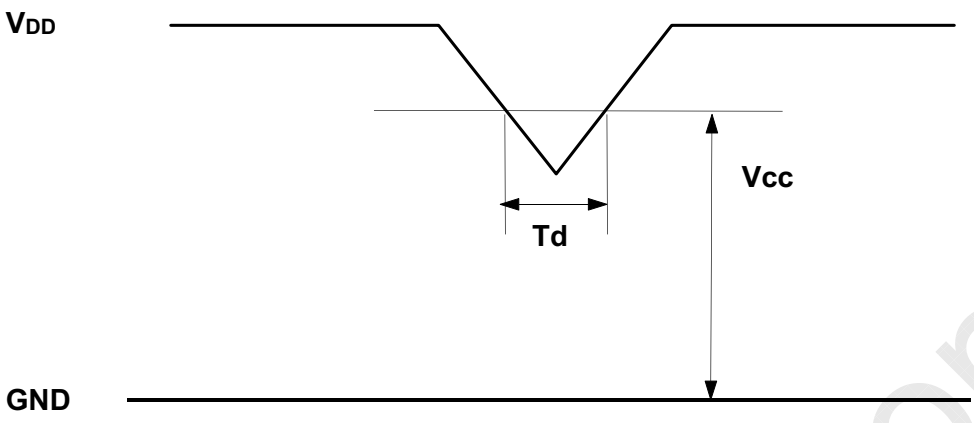
(2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily show abnormal screen.

(3) In case of VDD = off level,
please keep the level of input signals low or keep a high impedance.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal should not be kept at high impedance when the power is on.

6.4 V_{DD} Power Dip Condition



4.5V ≤ V_{DD} ≤5.5V
if V_{DD}(typ) x 20% ≤ Vcc ≤ V_{DD}(typ) x 10%,
then, 0<Td≤20msec

NOTE

(1) The above conditions are for the glitch of the input voltage.

(2) For stable operation of an LCD module power, please follow them.
i.e., if typ V_{DD} x 20% ≤ Vcc ≤ typ V_{DD} x 10%,
then Td should be less than 20ms.

6.5 LVDS Input Characteristics

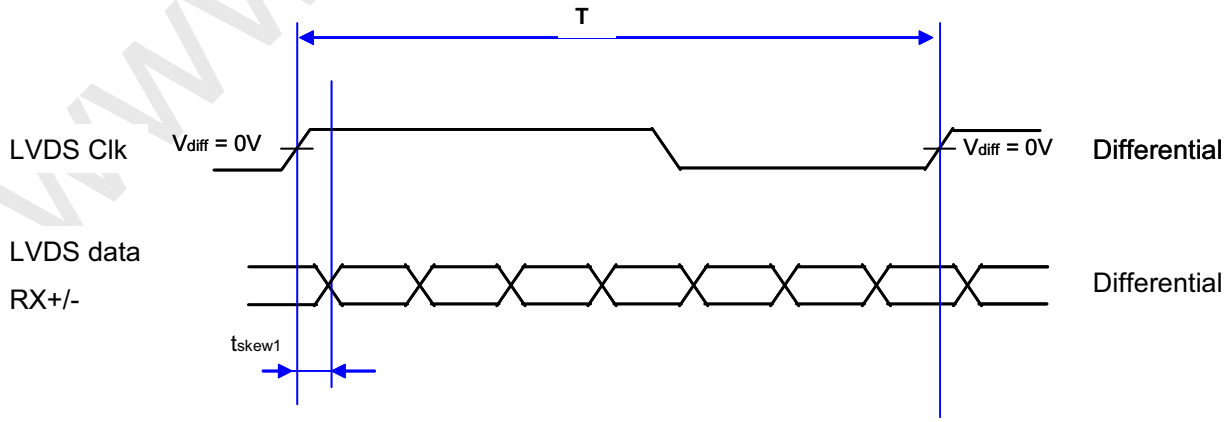
6.5.1 FPD-link (LVDS) Receiver input (RxCLKO/EP/N; RxIN/E[y]P/N, y=0,1,2,3)

Symbol	Parameter	Conditions	Min	Typ	Max	unit
V_{THLVDS}	Differential input high threshold	V_{CM} = +1.2V			+100	mV
V_{TLLVDS}	Differential input low threshold		-100			mV
V_{IN}	Input voltage range (single-ended)		0		2.4	V
$\|V_{ID}\|$	Differential input voltage		100		600	mV
V_{CM}	Common mode voltage		0+ $\|V_{ID}\|$ /2		2.4- $\|V_{ID}\|$ /2	V
I_{IN}	Input current	V_{IN}=2.4V, V_{DD}=3.6V			±10	μA
		V_{IN}=0V, V_{DD}=3.6V			±10	μA
RPLLS	FPD-link receiver phase lock look wake-up time				10	ms
tskew	skew between LVDS clock & LVDS data	F=85MHz V_{DD}=3.3V	-380		380	psec

Note

(1) LVDS Recevier DC parameters are measured under static and steady conditions which may not be reflective of its performance in the end application.

(2) tskew



where tskew : skew between LVDS clock & LVDS data,

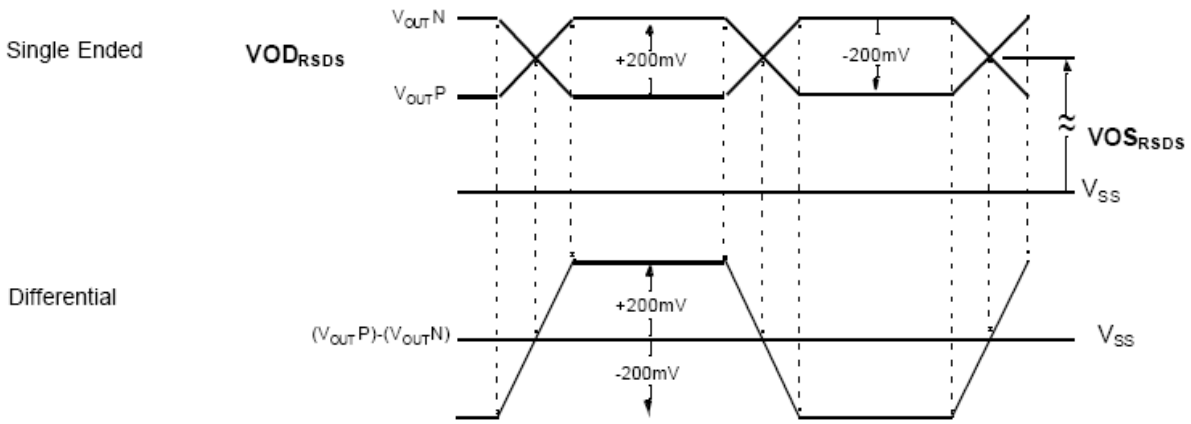
T : 1 period time of LVDS clock

cf) (-/+) of 380psec means LVDS data goes before or after LVDS clock.

6.5.2 RSDS™ Output (F/BCLKP/N, FBz[y]P/N; z=R, G, B, y=0, 1, 2)

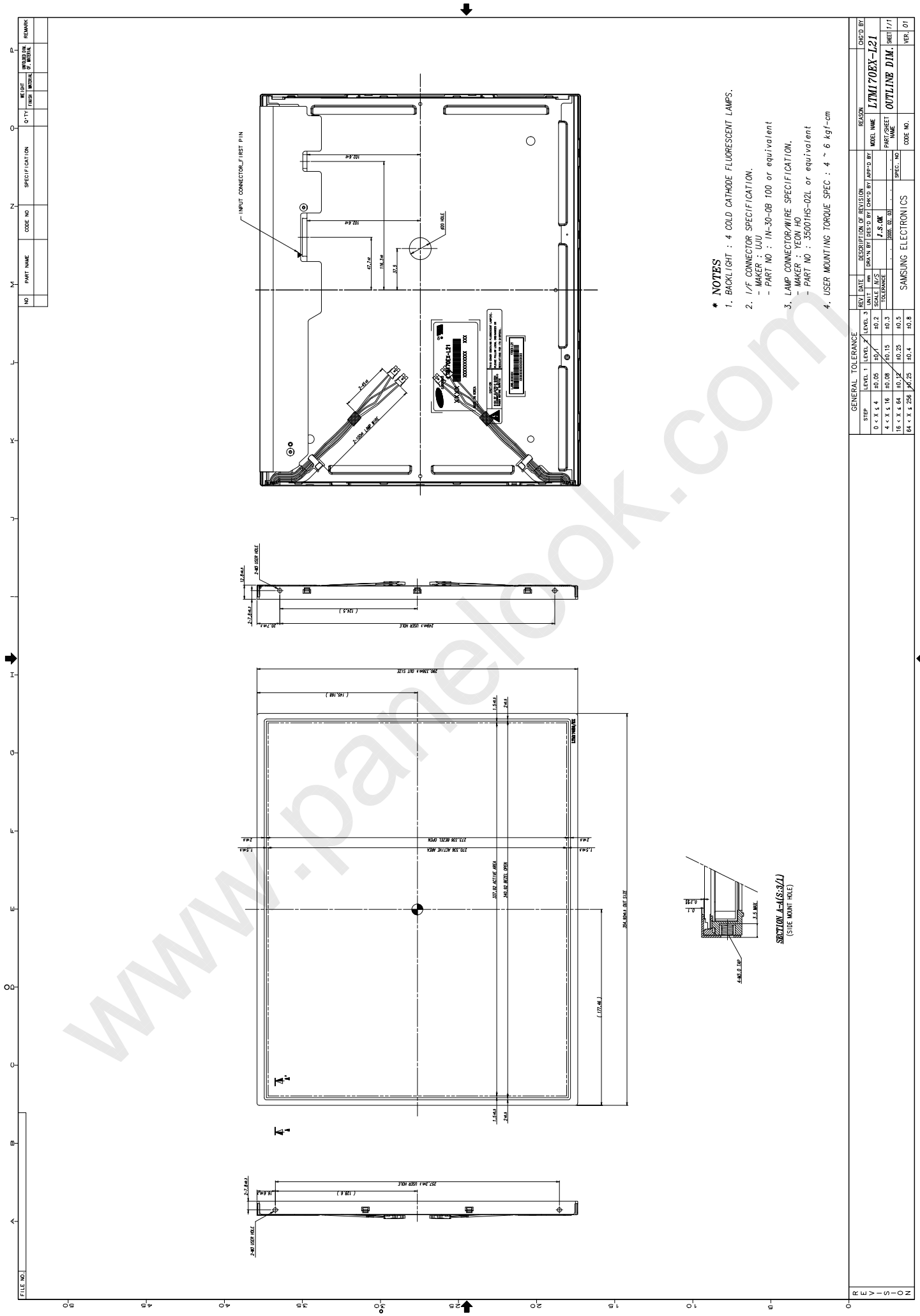
R_T=100Ω, I_{PI}=100μA

Symbol	Parameter	Conditions	Min	Typ	Max	unit
VOD_{RSDS}	Differential Output Voltage			±200		mV
VOS_{RSDS}	Offset Voltage			1.3		V



7. Outline Dimension

[Refer to the next page]



8. Reliability Test

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Test Items		Conditions	Time/Cycle	Sample
HTOL*		50°C , Bias	500 hrs	12
LTOL*		0°C , Bias	500 hrs	5
THB**		40°C / 95% , Bias	500 hrs	5
HTS***		70°C , No Bias	500 hrs	5
LTS***		-30°C , No Bias	500 hrs	5
Thermal Cycle		-20°C/30min ~ +60°C/30min , No bias	100 cycle	5
Box Drop		1 angle , 3 edge , 6 side , 66 cm		5
Shock (Non-operating)		50G , 11msec , ± x/y/z axis	1time/±axis	3
Vibration (Non-operating)		1.5G , 10~300 Hz x/y/z axis , sweep rate : 10 min	30min/axis	3
ESD	Non -Operating	CDM : 150pF, 330Ω, 9point, 3 times/point	± 10kV	3
	Operating	Contact : 150pF, 330Ω, 100point, once/point	± 8kV	3
		Air(non-contact) : 150pF, 330Ω, 100point, once/point	± 15kV	3

[Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these should be no change which may affect practical display functions.

* HTOL/ LTOL : High/Low Temperature Operating Life
** THB : Temperature Humidity Bias
*** HTS/LTS : High/Low Temperature Storage

9. PACKING

Approval

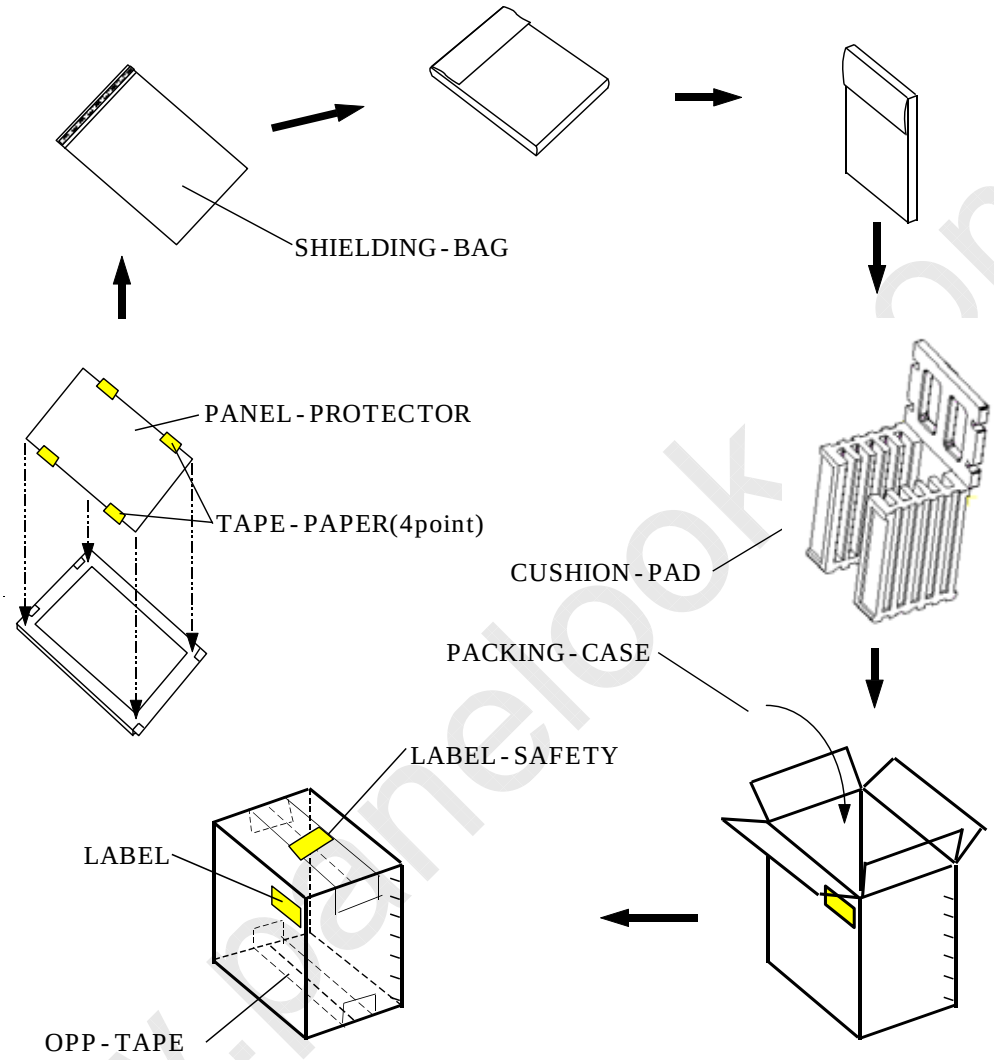
9.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method

a) Without Inverter



NOTE) 1) TOTAL Weight : Approx. 10 kg

2) Acceptance number of piling : 5 sets

3) Carton size : 390(W) X 320(D) X 410(H)

4) MAX accumulation quantity : 5 cartons

(3) Packing Material

No	Part name	Quality
1	Static electric protective sack	5
2	Packing case(Inner box) included shock absorber	1 set
3	Pictorial marking	2 pics
4	Carton	1 set

10. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

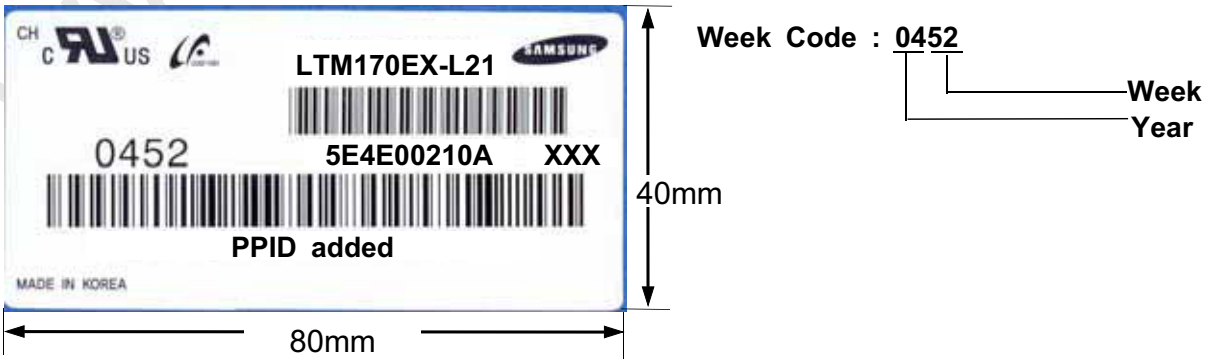
(1) Parts number : LTM170EX-L21
(2) Revision code : Two letters
(3) Customer code : One letter

X XX
Revision Code
Customer Code

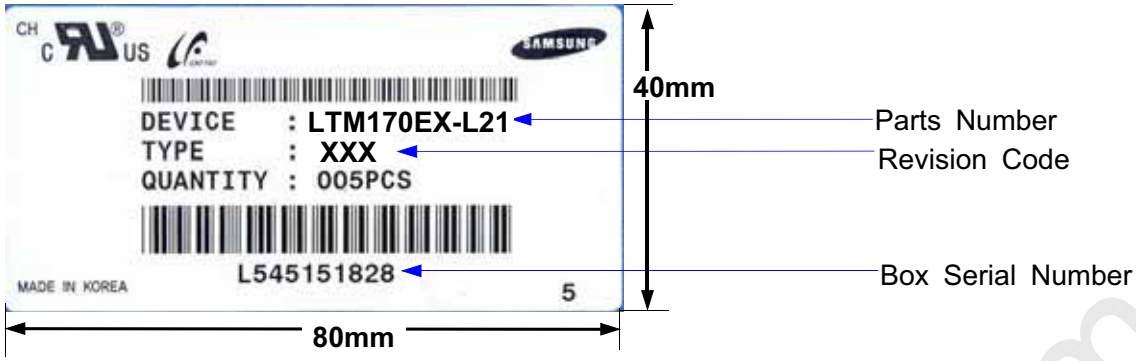
(4) Lot number : 5 E 4 E 00210A

Lot Number
Month
Year
Device
Line

(5) Nameplate Indication



(6) Packing box attach



(7) Others

1. After service part

(Lamps cannot be replaced because of the narrow bezel structure.)

11. Inspection Criteria

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When products are shipped, incoming inspection should be carried out with a sampling inspection based on MIL-STD-105E level II by AQL 1.0%.

CHANGE CONTROL

Design of the product may be changed regarding the specifications, appearance, parts used, circuits, etc. for product improvement.
If a design change is judged to affect the specifications of this product, supplier should inform customer of the change in advance.

QUALITY CONTROL

In the event of a product failure under normal operating conditions, a product trouble or a functional disorder that can be deemed to be the responsibility of supplier, supplier should repair the fault or replace the product free of charge within one year from the product delivery date. However, supplier does not take responsibility for the product quality in the case of modifications not specified by supplier.

MAINTENANCE

The specifications of the functions of maintenance parts may be partially changed within the range which provides equivalent or better quality.
In principle, maintenance parts should be product units.
When stopping manufacturing this product, supplier should notify customer in advance.

HANDLING OF DOUBTFUL POINTS

Any doubt not stipulated in this specification is to be resolved by mutual agreement between customer and supplier, and supplier should make efforts for improvement in good faith.

12. General Precautions

12.1 Handling

(a) When the module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the module.

(b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT back-light.

(d) Note that polarizers are very fragile and could be damage deasily. Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.

(i) Protect the module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the module.

(l) Do not pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the module.

(n) Protection film for polarizer on the module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

12.2 Storage

(a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

12.3 Operation

(a) Do not connect or disconnect the module in the "Power On" condition.

(b) Power supply should always be turned on/off by the item 6.3 "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back-light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

12.4 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the module may be damaged.

(d) If the module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.
To avoid image sticking, it is recommended to use a screen saver.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

(f) Please contact SEC in advance when you display the same pattern for a long time.